Topic of Deep Learning

Self Supervised Learning - Human Activity Recognition

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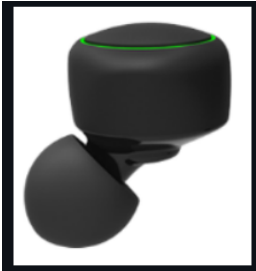
October 2023

Content

Data and Problem Statement

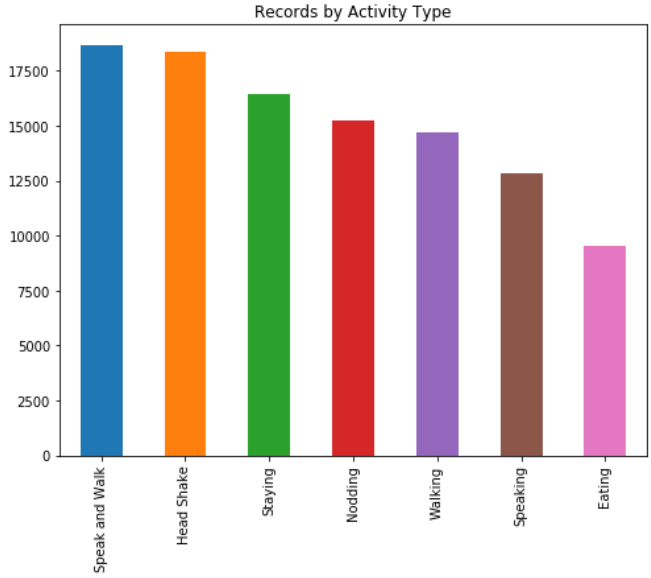
- Human Activity Recognition by Sensor data.
- shape of dataframe (105881, 9) = 1 Lakh data point
- Har Esense repository
- 6 feature ('ax', 'ay', 'az', 'gx', 'gy', 'gz')
- 7 classes ('Walking', 'Speaking', 'Speak and Walk','Staying','Eating', 'Head Shake','Nodding')

Data and Problem Statement



eSense is an earable device. It has built-in sensors which provides accelerometer and gyroscope data. From this data, human activities are recognized using machine learning algorithm.

Data and Problem Statement



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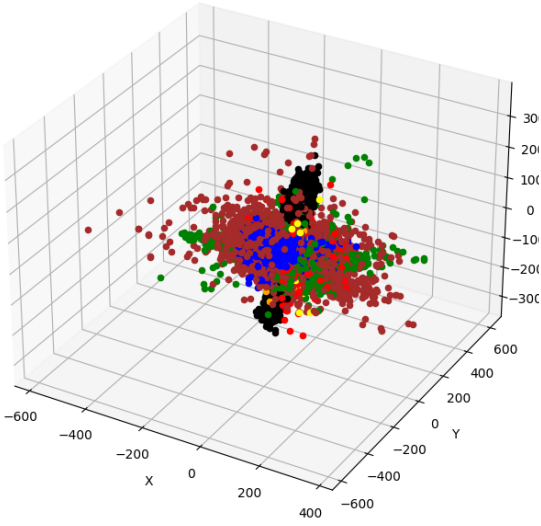
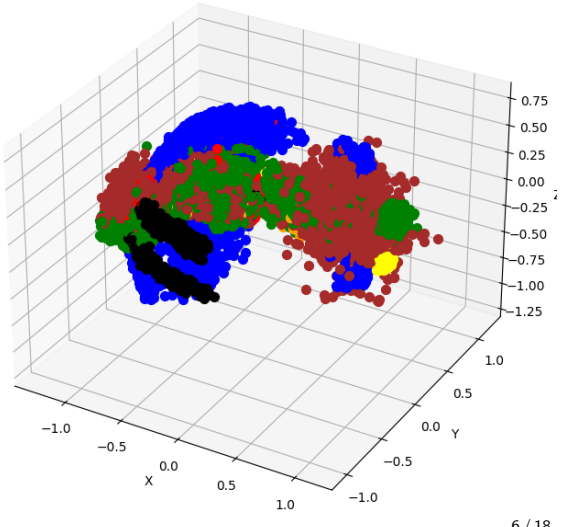
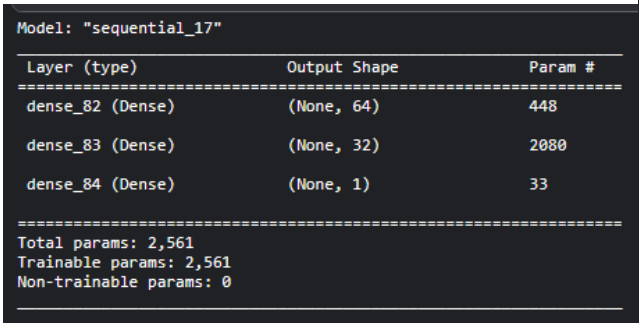




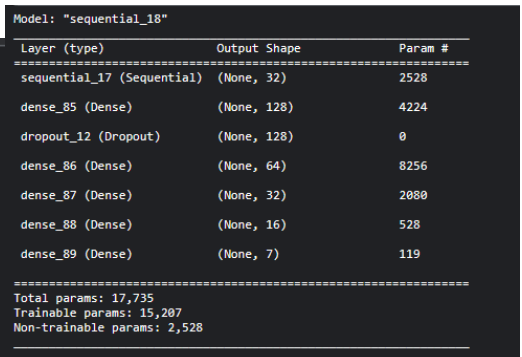
Pre-task

- Divided 7 activity in 2 pseudo label as Head activity and body activity
- Binary classification model for same is pre-task model
- Simple Dense layers is used for training.
- Training part include 6 feature and 7 class classification

Model Architecture: Pre-Task and Learning



```
Model: "sequential_17"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 dense_82 (Dense)            (None, 64)                448

 dense_83 (Dense)            (None, 32)                2080

 dense_84 (Dense)            (None, 1)                 33

=================================================================
Total params: 2,561
Trainable params: 2,561
Non-trainable params: 0
_________________________________________________________________
```

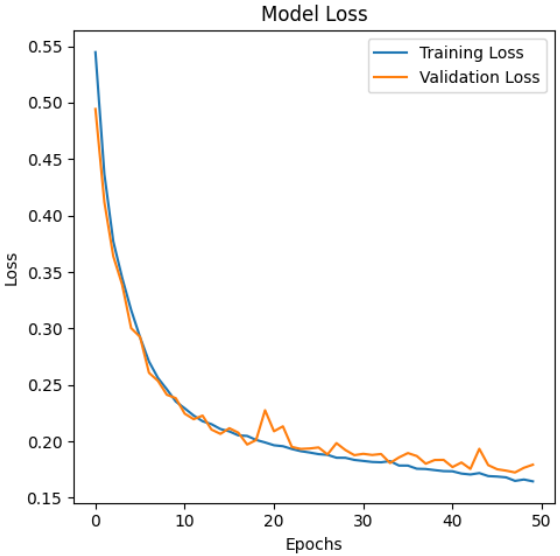


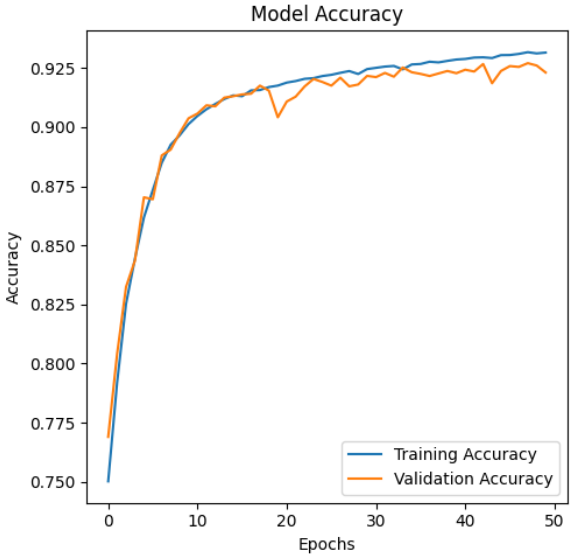
```
Model: "sequential_18"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 sequential_17 (Sequential)  (None, 32)                2528

 dense_85 (Dense)            (None, 128)               4224

 dropout_12 (Dropout)        (None, 128)               0

 dense_86 (Dense)            (None, 64)                8256

 dense_87 (Dense)            (None, 32)                2080

 dense_88 (Dense)            (None, 16)                528

 dense_89 (Dense)            (None, 7)                 119

=================================================================
Total params: 17,735
Trainable params: 15,207
Non-trainable params: 2,528
_________________________________________________________________
```

Model Architecture: Normal Classifier (No SSL)

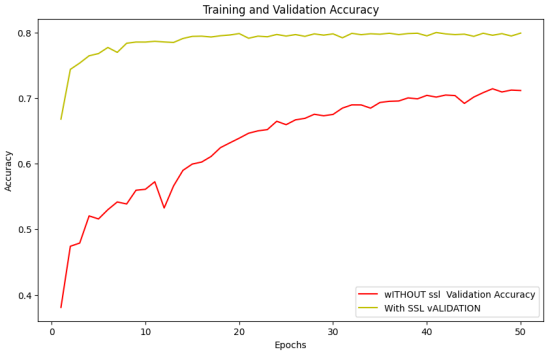
```
Model: "sequential_24"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 dense_116 (Dense)           (None, 64)                448

 dense_117 (Dense)           (None, 128)               8320

 dropout_17 (Dropout)        (None, 128)               0

 dense_118 (Dense)           (None, 64)                8256

 dense_119 (Dense)           (None, 32)                2080

 dense_120 (Dense)           (None, 16)                528

 dense_121 (Dense)           (None, 7)                 119

=================================================================
Total params: 19,751
Trainable params: 19,751
Non-trainable params: 0
_________________________________________________________________
```

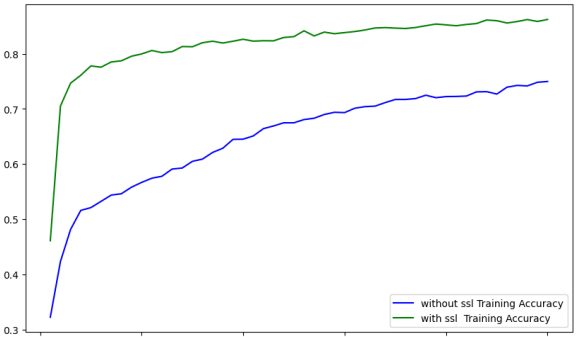
Result : Pre-Task



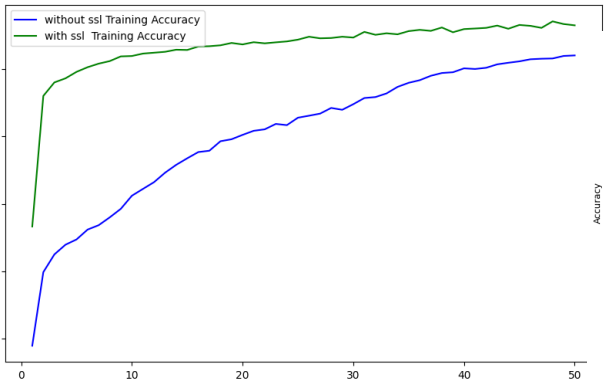


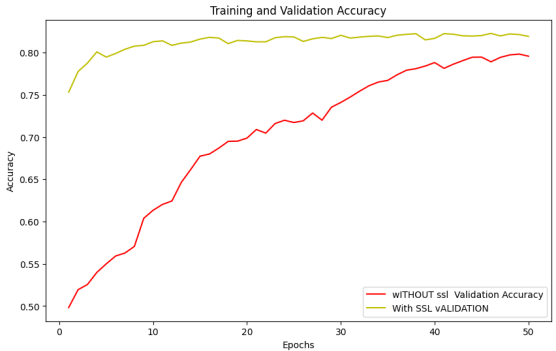
Results: SSL 5% data used for training



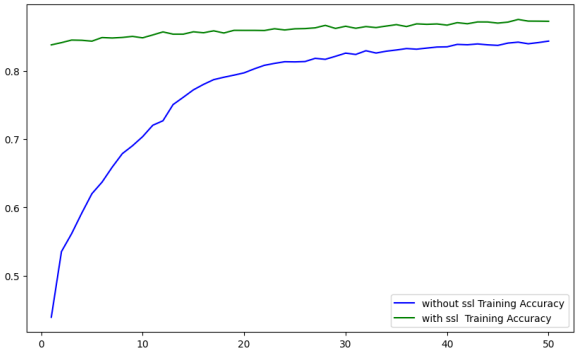


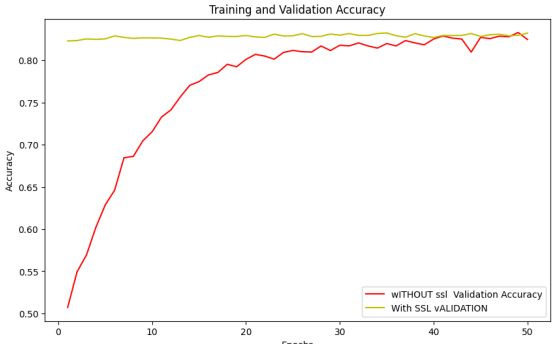
Results: SSL 10% data used for training





Results: SSL 20% data used for training

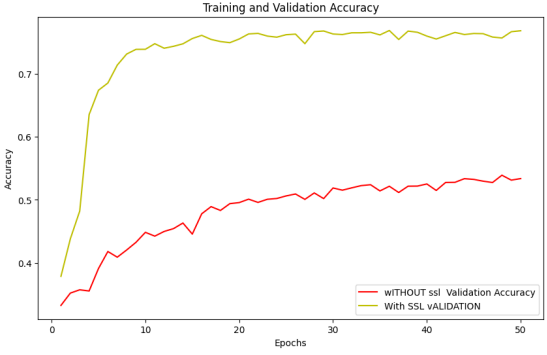


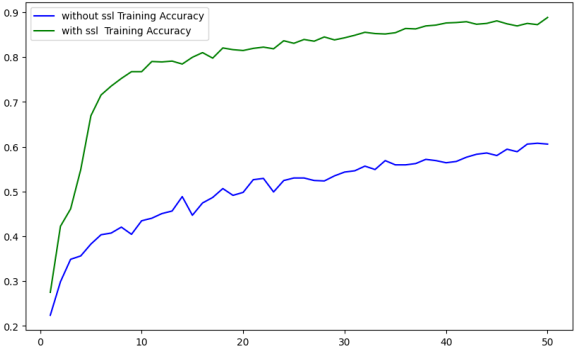


Observation

Without Self Supervised Learning		With self supervised Learning	
5% data for training	Accuracy	Accuracy	
Training Accuracy	75.65	87.84	
Val / Test Accuracy	73.12	80.47	
10% data for training			
Training Accuracy	82.14	88.81	
Val / Test Accuracy	79.97	81.47	
20% data for training			
Training Accuracy	84.24	87.87	
Val / Test Accuracy	82.58	81.92	

! ! Results: SSL 1% data used for training





Training on Just 1% data

without SSL Training accuracy : 60.59

without SSL Test accuracy : 53.38

with SSL Training accuracy : 88.85

with SSL Test accuracy : 76.82

Observation

- With self-supervised learning (ssl) faster convergence is observed as compared to Without SSL
- No Significant impact in Self Supervised Learning (SSL) Model is observed when training data is reduced
- Significantly high reduction of accuracy when reduced training data in without SSL case .

The End